



EXPOSURE WITH ELECTRONIC FLASH UNITS

KINDS OF ELECTRONIC FLASH

There are two kinds of electronic flash: manual and automatic. With manual units, you determine the proper lens opening from a guide number for the unit and film you're using or from a calculator dial on the flash unit. Automatic flash units contain a light-sensitive cell that sees the light reflected by the subject and automatically controls the flash output to produce correct exposure.

When you use an automatic flash unit set on automatic, set the lens opening according to the calculator dial on the flash unit or the flash instruction manual. Once you have set the lens opening, the flash unit will automatically adjust for the correct exposure within a specified distance range, for example, 3 to 15 feet.

With some automatic units you can use only one particular lens opening for each film speed while more versatile units give you a choice of two or more openings.

Automatic flash units usually have a manual setting that lets you choose the best lens opening for situations that might fool the automatic exposure control system. This can happen when a scene is unusually bright or dark. Fortunately, most flash scenes have normal reflectance or brightness, and the automatic control system works very well.

Some automatic units have an energy-saving (thyristor) circuit that lets you get more flashes per set of batteries than you would with a flash unit without this feature.

Some automatic flash units have an indicator which tells if there is sufficient light from the flash for proper exposure. With this indicator you can fire the flash before taking a picture and know whether you're within the proper distance range for the lens opening and speed of the film. This is especially helpful for bounce flash where exposure determination can be complex. See page 6.

Some cameras can set the flash exposure automatically as you focus on the subject. If you use an automatic flash unit with this type of camera, set the flash unit on manual. Then set the guide number for manual operation on the flash-guide-number scale of the camera.

GUIDE NUMBERS AND BCPS (BEAM-CANDLEPOWER-SECOND) RATINGS

When you take pictures with a manual flash unit or an automatic unit set on manual, you can determine the correct exposure from the recommended guide number in the same way that you determine exposure for flashbulbs. Divide the guide number by the flash-to-subject distance in feet to find the *f*-stop setting for your camera. To select the proper guide number, you need to know the light output of your electronic flash unit.

Most manufacturers of electronic flash units use a standard procedure in rating the light output of their units. According to this procedure, the quantity of light obtained from a flash unit is expressed in beam candlepower seconds, or BCPS. (Some manufacturers use effective candlepower seconds, or ECPS, which is approximately equivalent to BCPS.) Since the BCPS rating is a significant measurement of light output, you can use it to determine the correct guide number for your unit. You may find the BCPS output of your electronic flash unit in the instruction book, or you can request this information from the manufacturer.

When you know the BCPS rating for your flash unit, you can find the proper guide number in the table on page 8. For example, if the output of your unit is 1000 BCPS and your film has a speed of ASA 64, your guide number is 55. Or you can determine the electronic-flash guide number for any film by using the following formula:

$$\text{Guide Number} = \sqrt{0.05 \times \text{BCPS} \times \text{ASA Speed for Daylight}}$$

Some manufacturers publish watt-second ratings to specify light output of electronic flash. However, watt-seconds is an expression of electrical energy-storage capacity—*not a measurement of the light output* of an electronic flash unit. Two flash units with the same watt-second rating may produce significantly different amounts of light because of differences in reflector efficiency, electrical circuitry, type of flashtube, and method of triggering the flash. For this reason, don't use watt-second ratings to determine guide numbers.

DETERMINING YOUR OWN GUIDE NUMBERS

You can find guide numbers for electronic flash in many film instruction sheets, as well as in the *KODAK Master Photoguide* (AR-21), available from photo dealers. Published guide numbers and the guide numbers you can obtain from the formula may not be ideal for your equipment and conditions. Guide numbers can vary depending on specific equipment, surroundings in which you take your pictures, and personal taste. The most accurate way to obtain a guide number for your picture-taking situation is to make a photographic test with your camera and electronic flash unit.

You can make a guide-number test as follows: Set up an average subject 8 feet away from the flash unit. Choose surroundings for your subject that are typical of the scenes you will photograph. Use a color-slide film, such as *KODACHROME* 64 Film (Daylight). Set the flash synchronization on your camera at X, and set the shutter speed at 1/60 second. Then take a series of electronic-flash pictures, varying the camera lens opening by 1/2 stop for each shot. Take a picture at $f/5.6$, $f/6.7$, $f/8$, $f/9.5$, $f/11$, and $f/13$, as illustrated below. The half-stops $f/6.7$, $f/9.5$, and $f/13$ are not marked on cameras, but they are approximately halfway between the full-stop markings. Allow at least 30 seconds between pictures to make sure that the condensers in your flash unit are fully charged. This gives you full light output for each shot. Include a card identifying the f -stop used for each picture.

When you get your film back from processing, project the slides as you usually do and choose the best one. Multiply the f -stop that you used for the best slide by the flash-to-subject distance in feet. For example, assume that the best slide was taken at $f/9.5$. Then multiply: 8 feet \times 9.5 = 76. Thus 76 is the guide number for your flash unit and the film you used.

Once you have found the best guide number for the film you used in the test, you can find guide numbers for other films by referring to the table on page 8. If you made your test with *KODACHROME* 64 Film, which has a speed of ASA 64, locate 64 in the first column, under ASA Film Speed for Daylight. Then follow the line of guide numbers across until you find the guide number closest to the one determined by your test. In this instance, 80 is closest to your guide number 76. Mark the vertical column that includes

Electronic Flash Guide Number Test



the guide number from your test. Now you can use the guide numbers in that column with films of other speeds. The number at the top of the column is the approximate BCPS output of your electronic flash unit. For the example given, the flash unit has an output of 2000 BCPS.

When you have a reliable guide number for a certain film, you can determine guide numbers for other films another way by using the following formula:

$$\begin{array}{l} \text{Guide Number} \\ \text{for Film a} \end{array} = \begin{array}{l} \text{Guide Number} \\ \text{for Film b} \end{array} \times \sqrt{\frac{\text{ASA Speed of Film a}}{\text{ASA Speed of Film b}}}$$

FLASH DURATION

The ability of electronic flash to stop the action in photographs is one of its main advantages. The average manual electronic flash unit has an effective flash duration of 1/1000 second. The light-sensitive cell in automatic units controls the duration of the flash to produce correct exposure. The flash duration of these units can range from about 1/1000 second to as little as 1/50,000 second, depending on the flash-to-subject distance.

FLASH SYNCHRONIZATION

Electronic flash requires X synchronization. This is a no-delay setting which triggers your flash unit when the shutter is fully open. Since the duration of electronic flash is so brief, the camera shutter stays open for a period longer than the flash duration, even at very fast shutter speeds. As a result the shutter lets all of the light from the electronic flash pass through the lens regardless of shutter speed. Consequently, changing the shutter speed with electronic flash does not affect the guide number. With flashbulbs, guide numbers get smaller at higher shutter speeds.

Cameras with focal-plane shutters will synchronize electronic flash only at shutter speeds of 1/60 or 1/125 and slower. Cameras with leaf shutters and X synchronization will synchronize electronic flash at all shutter speeds. If your camera has adjustable synchronization, set the selector at X; if it doesn't, it has probably been preset by the manufacturer for X synchronization only. Check your camera instruction manual to make sure that your camera has proper synchronization for electronic flash.

If it's possible to look through the lens of your camera with the camera back open, you can check the flash synchronization to see if it is operating correctly. Before you put film in your camera, open the camera back. Place the flash unit close in front of the camera, facing toward the lens. Open the lens aperture all the way. Then fire the flash by tripping the camera shutter while looking through the lens from the back. If the camera and flash are working correctly, you will see a rectangular spot through the lens of a camera with a focal-plane shutter or a round spot of light with a leaf

shutter. If you see a smaller-than-normal rectangle or no rectangle at all with a focal-plane shutter, the camera and flash are not synchronized. If you take pictures with such a camera, you will get only part of the scene or no picture at all.

With a poorly synchronized leaf shutter, you will see the outline of the blades or no flash at all when you look through the lens from the back. Your pictures will be either underexposed or blank.

SHUTTER SPEED

As explained earlier, varying the shutter speed with electronic flash does not affect flash exposure. Use the fastest shutter speed at which your camera will synchronize electronic flash to minimize the possibility of registering the light present in the scene that you are photographing. The light in the scene may be of the wrong color quality for your color film. Using a faster shutter speed helps avoid this problem. If there is strong light present and you are photographing action, use a shutter speed fast enough to stop the action. This prevents double or ghost images. However, if stopping action is not a problem and you want to record remote background detail, use a slower shutter speed such as 1/30 second or slower. If you use shutter speeds slower than 1/30 second, you will need a tripod to hold your camera steady.



The ability to stop the action is one of the advantages of electronic flash.

DEVELOPMENT TIMES WITH BLACK-AND-WHITE FILMS

Your pictures will be acceptable if you use the recommended development times to develop most Kodak black-and-white films. However, because electronic flash is so brief, you'll get the best results if you increase the development time by 10 percent.

FILTERS WITH COLOR FILMS

Pictures taken with electronic flash and Daylight color film will usually have good color balance without the use of filters over the camera lens. However, flash units do vary; some units may produce pictures that are slightly bluish. If you have such a unit, you can improve the color balance of your pictures by using a yellowish filter such as a No. 81B light-balancing filter over the camera lens. When you use the No. 81B filter, increase exposure by 1/3 stop.

As some flash units age, the light from the flash tends to get slightly warmer in color, so after a time you may not need to use the filter. This color change is caused by the fact that the flash reflector or the plastic shield used over some flashtubes becomes yellow with age. Most modern electronic flash units do not change color with age.

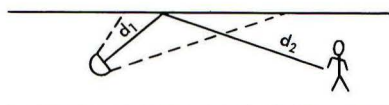
BOUNCE FLASH

Some electronic flash units have swivel flash heads so that you can aim them towards the ceiling or wall and bounce the light back onto your subject. This produces soft, even lighting similar to that found outdoors on an overcast day. With color film, aim the flash at a white or near-white surface. Otherwise, your subject may pick up some of the color of the reflecting surface.

The size and color of the room and the distance the light travels from the flash to the ceiling or wall and back to the subject affect exposure. Use at least 2 stops more exposure for bounce flash than for direct flash at the same distance.

To determine exposure more accurately, divide the flash guide number by the total distance from the flash to the ceiling and back to your subject. Then use a lens opening 1 stop larger than the resulting f -number.

Another way to determine exposure for bounce flash is to use the following formula:


$$f\text{-number} = 0.7 \left(\frac{\text{Guide number}}{d_1 + d_2} \right)$$

The letters d_1 and d_2 are the distance in feet.

These methods of determining exposure are for use with manual units or automatic units set on manual. The exposures are for clean, white ceilings. With off-white or light-colored ceilings, use 1/2 to 1 stop additional exposure. Make sure no direct light from the flash illuminates the subject.

The light-sensitive cell of an automatic flash unit must be aimed at your subject to determine exposure correctly. If your unit is not designed for bounce flash, the light sensor will always point in the same direction as the flash. If you aim the flash at the ceiling, the light sensor will read the light reflected from that surface and give the wrong exposure. Set your unit on manual and determine the exposure yourself.

CAUSES OF LIGHT LOSS

Recycling Time. After you have fired an electronic flash unit, it takes several seconds for the condensers in the power pack to recharge. Most electronic flash units have a ready light that comes on after about 10 seconds (depending on the unit) to indicate that the unit is ready to flash. But at this point you may get only about 65 percent of the total light output because the ready light does not necessarily indicate when the condensers in the unit are *fully* charged. Recycling time for full light output varies in practice and depends on the type of power pack, type and condition of batteries, and other factors. An automatic flash unit with an energy-saving circuit will recharge more quickly on automatic than a unit without this circuit. An ac-powered unit may recharge faster than a battery-powered unit.

You will get more consistent photographic results if you wait until your flash unit has recycled completely before taking the next picture. Allow at least 30 seconds between flashes, because it takes that long for the condensers in the typical unit to recharge fully. If necessary, you can take pictures more rapidly than this, but you may not get full light output from your flash unit. This can cause underexposed pictures, depending on the exposure latitude of the film you are using.

Weak Batteries. As the batteries in your flash unit lose power with use and age, the recycling time increases. When the battery power drops below the required level, the unit will lose light output even though it may still flash. Replace or recharge the batteries whenever the recycling time becomes excessive. It's also important to keep the battery and flash contacts clean by wiping them with a rough cloth.

De-forming of Condensers. Another factor which can weaken batteries and cause a loss of light output is the tendency of electrolytic condensers to "de-form" after a month or so of inactivity. When this happens it will take an extra-long time to "re-form" the condensers and bring them back up to a full charge. Re-forming the condensers builds up electrically the insulating layer which separates the metal foil from the electrolyte. This re-forming puts a considerable drain on the batteries. If you can use regular house current to power your unit, re-form the condensers by letting them recharge from the power line for an hour or so—and fire the flash a half dozen times—whenever the unit has been out of use for a few weeks. This helps your flash unit produce full light output.

GUIDE NUMBERS FOR ELECTRONIC FLASH										
ASA FILM SPEED FOR DAYLIGHT	BCPS OUTPUT OF ELECTRONIC FLASH UNIT									
	350	500	700	1000	1400	2000	2800	4000	5600	8000
20	18	22	26	32	35	45	55	65	75	90
25	20	24	30	35	40	50	60	70	85	100
32	24	28	32	40	50	55	65	80	95	110
40	26	32	35	45	55	65	75	90	110	130
50	30	35	40	50	60	70	85	100	120	140
64	32	40	45	55	65	80	95	110	130	160
80	35	45	55	65	75	90	110	130	150	180
100	40	50	60	70	85	100	120	140	170	200
125	45	55	65	80	95	110	130	160	190	220
160	55	65	75	90	110	130	150	180	210	250
200	60	70	85	100	120	140	170	200	240	280
250	65	80	95	110	130	160	190	220	260	320
320	75	90	110	130	150	180	210	250	300	360
400	85	100	120	140	170	200	240	280	340	400
500	95	110	130	160	190	220	260	320	370	450
650	110	130	150	180	210	260	300	360	430	510
800	120	140	170	200	240	280	330	400	470	560
1000	130	160	190	220	260	320	380	450	530	630
1250	150	180	210	250	300	350	420	500	600	700
1600	170	200	240	280	340	400	480	560	670	800

MORE INFORMATION

If you have any additional questions about the use, care, or handling of electronic flash units, write to Eastman Kodak Company, Photo Information, Department 841S, 343 State Street, Rochester, New York 14650.

Consumer Markets Division



Rochester, New York 14650

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